International Journal of Production Research ›
Volume 52, 2014 - Issue 2

Articles

Reduction of power consumption and carbon footprints by applying multi-objective optimisation via genetic algorithms

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Pages 337-352 | Received 24 May 2012, Accepted 26 Jun 2013, Published online: 12 Aug 2013

Cite this article https://doi.org/10.1080/00207543.2013.825740 Check for updates

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Abstract

Firms heavily emphasise reducing carbon footprint, an area warranting further improvement. This study examines carbon footprint within the context of production scheduling. Two multi-objective scheduling problems involving economic- and environmental-related criteria are studied: (1) a batch-processing machine scheduling problem to minimise the total weighted tardiness and carbon footprint simultaneously; (2) a triple-criteria scheduling problem involving of a hybrid flow shop consisting of a batch-processing machine followed by two parallel-processing machines, in which the shop attempts to minimise the total weighted tardiness, carbon footprint and peak power. Since the above problems are treated as a true multi-objective optimisation problem, decision-makers should select a solution among the trade-off solutions provided in the Pareto-optimal set. Therefore, the non-dominated sorting-based genetic

algorithm II (NSGA-II) is implemented, which identifies the set of approximate efficient schedules to both multi-objective scheduling problems. Moreover, an adaptive multi-objective genetic algorithm (AMGA) is developed to generate the reference Pareto front, which validates the results that are obtained using NSGA-II. Results of this study demonstrate both the effectiveness of AMGA in converging to the true Pareto-optimal set and the efficiency of NSGA-II.

Keywords:

scheduling | carbon footprint | total weighted tardiness | multi-objective genetic algorithms